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Solution by C. HORNUNG, A. M., Heidelberg University, Tiffin, Ohio, and G. B. M. ZERR, A. M., Ph. D., The Temple College, Philadelphia, Pa.

The altitude of the cone of which the given frustum is a part is easily found to be $Dl\div(D-d)$.

Let x=length of the required beam ; then the diameter of the circle circumscribing the end of the beam is found to be $\dfrac{Dl-(D-d)x}{l}$, and the area of the end or section$=\dfrac{[Dl-(D-d)x]^2}{2l^2}$.

$\therefore$ the volume of the beam, $V=\dfrac{[Dl-(D-d)x]^2x}{2l^2}$.

Placing the first derivative of V equal to zero, and solving for x we have

$$x=\tfrac{1}{3}lD\div(D-d), \text{ or } lD\div(D-d).$$

The first of these values of x renders V a maximum, which was to be proved.

Also solved by *J. SCHEFFER*, and *W. O. PRUITT*.

117. **Proposed by G. B. M. ZERR, A. M., Ph. D., Professor of Chemistry and Physics, The Temple College, Philadelphia, Pa.**

A frustum of a paraboloid of revolution closed at both ends has a given volume. Find its interior dimensions when its surface is a minimum.

Solution by the PROPOSER.

Let $y^2=4ax$ be the equation to the parabola, c=capacity of frustum.

$\therefore \tfrac{8}{3}\pi\sqrt{a}[(x_2+a)^{\frac{3}{2}}-(x_1+a)^{\frac{3}{2}}]+4\pi a(x_2+x_1)=u=$minimum.

$2\pi a(x_2^2-x_1^2)=c\ldots.(2)$.

$\therefore \dfrac{dx_2}{dx_1}=\dfrac{(x_1+a)^{\frac{1}{2}}-\sqrt{a}}{(x_2+a)^{\frac{1}{2}}+\sqrt{a}}\ldots.(3)$, from (1).

$\dfrac{dx_2}{dx_1}=\dfrac{x_1}{x_2}\ldots.(4)$, from (2).

$$\frac{dx_2}{da}=-\frac{(x_2+a)^{\frac{3}{2}}-(x_1+a)^{\frac{3}{2}}+3a(x_2+a)^{\frac{1}{2}}-3a(x_1+a)^{\frac{1}{2}}+3\sqrt{a}(x_2+x_1)}{3a(x_2+a)^{\frac{1}{2}}+3a\sqrt{a}}\ ..(5).$$

$\dfrac{dx_2}{da}=-\dfrac{x_2^2-x_1^2}{2ax_2}\ldots.(6)$.

From (3) and (4), $x_1=\dfrac{x_2\{x_2-2a-2\sqrt{[(x_2+a]a}\}}{[\sqrt{(x_2+a)}+\sqrt{a}]^2}$, or $x_1=0$.

Eliminating dx_2/da between (5) and (6) and substituting $x_1=0$, we get

$$(8a-x_2)\sqrt{(x_2+a)}=(8a+3x_2)\sqrt{a}.$$

$\therefore x_2=24a\ldots.(7)$. From (2) and (7),

$$x_2=\left(\frac{12c}{\pi}\right)^{\frac{1}{3}},\ a=\tfrac{1}{24}\left(\frac{12c}{\pi}\right)^{\frac{1}{3}}.$$

Also solved by *J. SCHEFFER*.